AD-A132 447 OPERATING AND SUPPORT COST ESTIMATING GUIDE SAMPLE 1/1
ANALYSIS ARMY HEL..(U) COST ANALYSIS IMPROVEMENT GROUP
WASHINGTON D C 01 JAN 80

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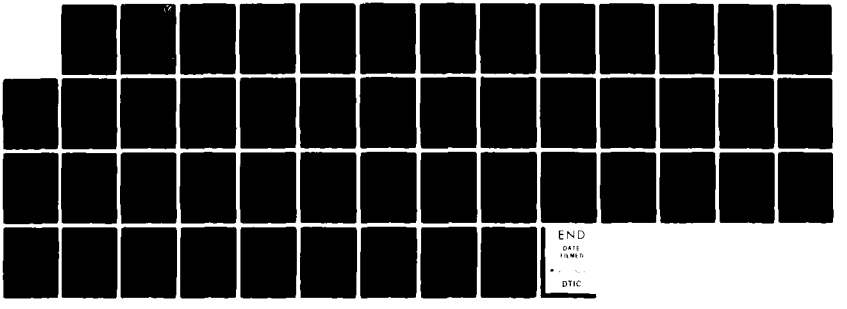

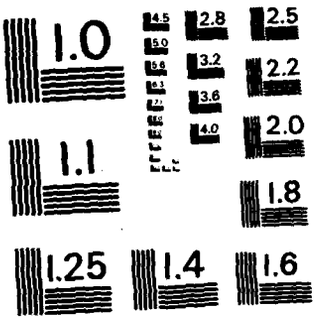

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OPERATING

and

SUPPORT

COST ESTIMATING GUIDE

SAMPLE ANALYSIS
ARMY HELICOPTER AT DSARC II

* * *

Office of the Secretary of Defense
Cost Analysis Improvement Group

1 January 1980

FORWARD

DOD Directive 5000.4 "OSD Cost Analysis Improvement Group", provided the charter for the Cost Analysis Improvement Group (CAIG) to review and establish criteria, standards, and procedures concerning the preparation and presentation of cost estimates on defense systems to the DSARC and CAIG. In support of this objective, the CAIG has periodically issued guidance for development and presentation of Operating and Support (O&S) cost for OSD review. To date general guidance has been made available for aircraft, ships, and ground combat vehicles.

In consonance with that general guidance, the following sample of a CAIG Operating and Support Cost Estimate Report covering a hypothetical case has been developed to further assist the cost analyst in the preparation of cost estimating reports submitted to the DSARC and CAIG during the acquisition process of a new weapon system.

This sample is not intended to imply the existence of a specific acquisition program. Nor does it imply a preference for one analysis technique over another. The sample is intended to show an example of how Operating and Support Costs can be developed for CAIG review with available data bases and one example of an appropriate format for presentation of cost estimates.

The data bases used were used only to illustrate the need to relate an estimate to an existing similiar system and to ensure a constant relationship between values and the Cost Element Structure. It is not used to promulgate the use of specific data bases. Each case should address that data which is the most complete and accurate for its purposes. Further, the level of detail depicted in this example may be greater or less than that which is available or appropriate to a specific case.

The cost element structure (CES) used in this example conforms to Army Pamphlet 11-4 with the exception of Depot Maintenance. For Depot Maintenance a modification of the cost element structure, from the CAIG Aircraft Operating and Support Cost Development Guide was used. It was felt that Army depot cost reports provide sufficient historical data to support this more detailed analysis of depot repair costs. However, the CES used in an actual acquisition program cost report would result from a detailed assessment of program requirements and negotiations with the CAIG.

EXECUTIVE SUMMARY

Operating and Support (O&S) costs for the UAH-X and the current mixed systems (baseline) are shown below. These figures are compared to the figures presented to the DSARC at Milestone I.

DSARC I to DSARC II Comparison
Constant FY 80 $ - Millions

	DSARC I		Current Estimate	
	Existing Co.	UAH-X	Existing Co.	UAH-X
$/Assault Co/yr	7.8	9.6	8.1	10.2
$/Air Cavalry Co/yr	8.1	9.6	8.4	10.2
$/Air Ambulance Co/yr	7.5	9.6	7.7	10.2
Annual Force Costs	542.7	575.0	561.6	614.0
20 yr Force O&S	-	7781.4	-	8309.2

The force O&S costs are based on a five year delivery schedule plus fifteen years of full force operations at 27 flying hours per month per PAA . . . .

The costs growth reflected in both the baseline and the UAH-X system is due mainly to the rise in POL costs. This is in spite of a four hour per PAA per month reduction in the projected flying hour program. The current estimate of the UAH-X costs also includes costs covering an increase of 24 medics per company . . . .

Although the UAH-X represents a dramatic increase in performance and flexibility, O&S costs will increase by only 9% over the current force mix. By standardizing assault, air cavalry and Air Ambulance companies the total force can be reduced to 60 composite helicopter companies . . . .

GUIDANCE: THE EXECUTIVE SUMMARY IS A SIMPLE ONE PAGE NARRATIVE PROVIDING THE BOTTOM LINE COSTS, FORCE SIZE AND MAJOR COSTS DRIVERS, AND ASSUMPTIONS. INCLUDE A BRIEF EXPLANATION OF DIFFERENCES PREDICTED FROM THE BASELINE SYSTEM AND THE DSARC MILESTONE I COST ESTIMATIONS.

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CONTENTS

1. INTRODUCTION

The following cost analysis report is submitted in support of Defense Systems Acquisition Review Council (DSARC) Milestone II review of the UAH-X Program . . . . All values included in this report are in FY 80 dollars unless indicated otherwise.

GUIDANCE: IDENTIFY THE MILESTONE MISSION ELEMENT NEEDS STATEMENT (MENS) AND DECISION COORDINATING PAPER (DCP) WITH DATE AND THE BASE YEAR FOR COSTS IN THE INTRODUCTION.

The existing fleet of utility and attack helicopters were designed in the late 1950s and 1960s. Although these weapons systems have proven to be capable aircraft, their design is based on technology which will be over 30 years old in the 1990s. Their lack of configuration flexibility render them . . . .

GUIDANCE: INCLUDE A SHORT STATEMENT SUMMARIZING THE MENS/DCP AND ANY SIGNIFICANT DEVIATIONS THAT THE COST ANALYSIS MAKES FROM THE DOCUMENTS.

The objective of this program is to provide a general purpose platform for rapid supplies or troop deployment and medical evacuation, which can simultaneously provide fire surpression and general close air support to a forward battle zone . . . . In lieu of maintaining composite companies with utility and attack helicopters, a standard company with a single type helicopter capable of performing all missions . . . . results in a reduction of total helicopter companies from 69 to 60 companies . . . .

. . . Based on an evaluation of paper designs from . . . competing contractors, the UAH-X design met all operational requirements and was found to be most cost efficient in terms of supporting maintenance manpower and fuel consumption. A prototype has been built and flown by the selected contractor to evaluate areas of risk . . . . An artist's rendition/picture of this design is presented as Figure 1

GUIDANCE: ALSO, OUTLINE THE PROGRAM, ITS STAGE OF DEVELOPMENT, MAJOR SYSTEM PARAMETERS, AND MAJOR POTENTIAL RISKS THAT IMPACT OPERATING AND SUPPORT (O&S) COSTS.

Table 1 presents the Operating and Support (O&S) costs for the baseline and the prototype helicopter. The data is shown for a company operating for one year . . . .

In Table 2 the cost estimates presented at DSARC I are tracked to the current estimate and reasons for significant variances given . . . .

Table 3 presents the O&S costs for the life cycle of the prototype system with the procurement delivery schedule as listed in the Material System Requirements Specification for the UAH-X dated . . . .

These costs are based on a company of mature aircraft. To account for non-operating time due to aircraft delivery schedules, all aircraft delivered within a given year are assumed to accrue costs for only half of the year of delivery.

GUIDANCE: THE TABLE LISTING THE O&S ANNUAL COSTS FOR A TYPICAL DEPLOYABLE UNIT SHOULD REFLECT THE COST ELEMENT STRUCTURE (CES) ARRIVED AT THROUGH CONSULTATION WITH THE COST ANALYSIS IMPROVEMENT GROUP (CAIG). THE COSTS SHOULD ALSO BE COMPARED TO THOSE PRESENTED TO THE DSARC AT MILESTONE I AND THE COSTS DIFFERENTIALS EXPLAINED. THE O&S COSTS SHOULD ALSO BE PRESENTED BY FISCAL YEAR. THESE FIGURES SHOULD BE IDENTICAL TO THE FIGURES PRESENTED IN THE INTEGRATED PROGRAM SUMMARY (IPS) WITH THE DELIVERY SCHEDULES IDENTIFIED IN THE MATERIEL SYSTEM REQUIREMENTS SPECIFICATION.

Figure 1. U/H-X Helicopter

TABLE 1 ANNUAL OPERATING AND SUPPORT COSTS
(THOUSANDS, FY80$)

27FH/PAA/YR

PAA	Composite Co 24-UAH-X		Assault Co 23-UH-1H 6-AH-1G		Air Cavalry Co 18-UH-1H 9-AH-1G		Air Ambulance Co 25-UH-1H	
Cost Element								
Military Personnel		3092		2581		2884		2830
Crew P&A	1054		921		966		1097	
Maintenance P&A	943		987		990		724	
Indirect P&A	940		543		783		866	
PCS	155		130		145		143	
Consumption		2718		1953		1909		1539
Replen Spares	948		809		739		717	
POL	1180		988		939		813	
Ammo & Missiles	590		156		231		9	
Depot Maintenance		2340		1892		1741		1661
Airframe Repair	571		370		328		338	
Engine Repair	466		281		273		227	
Component Repair	1292		1232		1131		1088	
Transportation	11		9		9		8	
Modification Material		276		195		187		160
Other Direct Spt. Ops		Not Available						
Maint Civil Labor	-		-				-	
Other Direct	-		-				-	
Indirect Spt Ops		1807		1497		1643		1533
Pers Replacement	111		92		104		99	
Trans, Patients and Prisoners	106		88		99		97	
Quarters Maint and Utilities	140		116		131		124	
Medical Support	73		60		68		64	
Other Indirect	1377		1141		1241		1149	
Total Cost Per Company		10,233		8118		8364		7723
Total Companies		60		24		30		15
Annual Force Costs (Mature Force)		613,980		194,832		250,920		115,845

TABLE 2 DSARC I TO DSARC II COMPARISON
ANNUAL OPERATION AND SUPPORT COSTS
(THOUSANDS, FY80$)

1 COMPANY, 24 PAA

Cost Element	Current Est	DSARC I Est	Change	Comments
Military Personnel	3092	2766	+ 326	
Crew P&A	1054	1028	+ 26	1
Maintenance P&A	943	920	+ 23	1
Indirect P&A	940	667	+ 273	1,2
PCS	155	151	+ 4	1
Consumption	2718	2666		
Replen Spares	948	948	0	
POL	1180	1129	+ 51	4
Ammo and Missiles	590	589	+ 1	1
Depot Maintenance	2340	2313		
Airframe Repair	571	550	+ 21	3
Engine Repair	466	460	+ 6	3
Component Repair	1292	1292	0	
Transportation	11	11	0	
Modification Material	276	269	+ 7	5
Other Direct Spt. Ops	Not Available			
Maint. Civil. Labor	Not Available			
Other Direct	Not Available			
Indirect Spt. Ops	1807	1569	+ 238	
Pers. Replacement	111	106	+ 5	1,2
Trans, Patients and Prisoners	106	104	+ 2	1,2
Quarters Maint and Utilities	140	136	+ 4	1,2
Medical Support	73	71	+ 2	1,2
Other Indirect	1377	1152	+ 225	1,2
Total Cost	10,233	9,583		

Notes:
1. Change due to changes in the Oct. 79 AFPCH figures
2. 24 Medics have been added to the Composite Company TOE.
3. FY80 Depot Maintenance figures used vice FY79 Data.
4. Fuel consumption estimate increased from 110 gal/hr to 115 gal/hr and cost increase from $1.18/gal to $1.32/gal.
5. Due to production cost increase (Reduced buy)

TABLE 3 TYPICAL UAH-X FORCE OPERATING AND SUPPORT COST
FISCAL YEAR BREAKOUT
(MILLIONS, CONSTANT FY20$)

2046 AIRCRAFT, 60 COMPANIES

FISCAL YEAR	86	87	88	89	90	91	92	1993-2002	2003	Total
No. of Operating Companies	0	2	14	26	37	47	57	60	59	
Deliveries**	5	50	300	300	300	300	300	491		2046
MILPERS										
Crew P&A		1.1	8.4	21.1	33.2	44.3	54.8	630.8	62.2	855.9
Maintenance P&A		.9	7.5	18.9	29.7	39.6	49.0	564.4	55.6	765.6
Indirect P&A		.9	7.5	18.8	29.6	39.5	48.9	562.6	55.5	763.3
Subtotal*		2.9	23.4	58.8	92.5	123.4	152.7	1757.8	173.3	2384.8
O&M										
PCS		.1	1.2	3.1	4.9	6.5	8.1	92.8	9.1	125.8
POL		1.2	9.4	23.6	37.2	49.6	61.4	706.2	69.6	958.2
Ammo and Missiles		.6	4.7	11.8	18.6	24.8	30.7	353.1	34.8	479.1
Depot Airframe Repair		.6	4.6	11.4	18.0	24.0	29.7	341.7	33.7	463.7
Depot Engine Repair		.5	3.7	9.3	14.7	19.6	24.2	278.9	27.5	378.4
Depot Component Repair		1.3	10.3	25.8	40.7	54.3	67.2	773.3	76.2	1049.1
Transportation		0	.1	.2	.3	.5	.6	6.6	.6	8.9
Pers Replacement		.1	.9	2.2	3.5	4.7	5.8	66.4	6.5	90.1
Trans, Patient, Prisoners		.1	.8	2.1	3.3	4.5	5.5	63.4	6.3	86.0
Quarters Maintenance and Utilities		.1	1.1	2.8	4.4	5.9	7.3	83.8	8.3	113.7
Medical Support		.1	.6	1.5	2.3	3.1	3.8	43.7	4.3	59.4
Other Indirect		1.4	11.0	27.5	43.4	57.8	71.6	824.1	81.2	1118.0
Subtotal*		6.1	48.4	121.3	191.3	255.3	315.9	3634.0	358.1	4930.4
PROCUREMENT										
Replenishment Spares		.9	7.6	19.0	29.9	39.8	49.3	567.4	55.9	769.8
Modification Material		.3	2.2	5.5	8.7	11.6	14.4	165.2	16.3	224.2
Subtotal*		1.2	9.8	24.5	38.6	51.4	63.7	732.6	72.2	994.0
Grand Total*		10.2	81.6	204.6	322.4	430.1	532.3	6124.4	603.6	8309.2

**Delivery Schedule is based on Materiel System Requirements Specification on UAH-X dated _____.

GUIDANCE: *NOTE: FIGURES ARE ALSO INCLUDED IN ANNEX B OF THE INTEGRATED PROGRAM SUMMARY

2. ASSUMPTIONS AND GROUND RULES

2.1 General.

Although still under development, the avionics is expected to include between 50% and 55% plug in circuit boards and 40% throwaway circuit chips . . . . The maintenance manning, reliability, maintainability, and material/spare consumption figures reflect this changing technology . . . .

The earlier program review was predicated on the assumption of a high level of embedded wiring in UAH-X. In manufacturing the prototype aircraft it was found that embedded wiring was not practical, therefore, ...

GUIDANCE: INCLUDE A GENERAL DESCRIPTION OF SYSTEM CHANGES AND DISCUSS THEIR ANTICIPATED IMPACTS ON O&S COSTS INDICATING THE DEGREE OF CONFIDENCE THAT THE CHANGES ARE PRACTICAL AND COST IMPACTS ARE ACCURATE.

2.2 Baseline System.

As in the DSARC I report, existing Assault, Air Cavalry, and Air Ambulance companies were used as the reference system. However, the data base was updated to include the latest year's data. The mission profiles will not change with the introduction of the UAH-X . . . .

GUIDANCE: IDENTIFY THE BASELINE SYSTEM AND EXPLAIN THE RATIONALE USED IN ITS SELECTION. IF THE BASELINE SYSTEM WAS CHANGED FROM DSARC I EXPLAIN FULLY WHY THE CHANGE WAS NECESSARY.

2.3 System and Program Characteristics.

Table 4 illustrates aircraft and program characteristics of the helicopter . . . .

GUIDANCE: INCLUDE DETAILS OF THE ALTERNATIVE SYSTEM.

TABLE 4. HELICOPTER CHARACTERISTICS

Element	Utility (UH-1H)	Attack (AH-1G)	Composite UAH-X
Power Plant	T53-L-13B (1400SHP)	T53-L-13 (1400SHP)	T53-L-15A (2950SHP)
Main Rotor (Dia)	48 ft	44 ft	50 ft
(Chord)	21 in	27 in	30 in
Fuel Capacity	220 gal	262 gal	290 gal
Weight			
Empty	5210 lbs	5816 lbs	8500 lbs
Max	9500 lbs	9500 lbs	15000 lbs
Hover Ceiling	13600 ft	9700 ft	16000 ft
Missions			
Troop Transport	14 troops	0	14 troops
Cargo Transport	4000 lbs	0	4000
Medical	6 litters	0	6 litters
	2 attendents	0	2 attendents
Attack			
External Ord	0	542 lbs	542 lbs*
Internal Ord	0	2270 lbs	2270 lbs*

*Simultaneous with other missions

2.4 Assumptions, Model Inputs, and Rates.

2.4.1 Design Sensitive Values.

Table 5 lists the elements that are design-related . . . .

TABLE 5. DESIGN SENSITIVE VALUES

Elements	Values	Source	OPR	Ext
1. Unit Production Costs	$2.3M	PM Projection	Jim Smith	75124
2. Portion of Flyaway Costs for Material	53%	Contractor Estimate	Jim Smith	75124
3. AMPR Weight	7,000 lbs	PM Projection	John Doe	73124
4. Avionics Weight	1,500 lbs	PM Projection	John Doe	73124
5. Fuel Consumption	115 gal/hr	See paragraph 3.3	John Doe	73124

2.4.1.1 Unit Production Costs.

The prototype manufacturing costs was compared with the prototype manufacturing costs of recent aircraft acquisitions and UAH-X unit production costs projected based on other unit production costs . . . .

2.4.1.2 Portion of Flyaway Costs for Material . . . .

2.4.1.5 . . . .

GUIDANCE: DIVIDE VALUES USED IN THE COST ESTIMATING MODEL OR ALGORITHMS INTO TABLES DEPENDING ON THE NATURE OF THE PARAMETER INVOLVED.
TABLE 5 CONTAINS ELEMENTS WHICH ARE INHERENT TO THE SYSTEM DESIGN AND ARE DEPENDENT ON HARDWARE CONFIGURATION. FOLLOWING THIS TABLE IS A BRIEF EXPLANATION OF THE DERIVATION OF THE VALUE SELECTED FOR THE PARAMETER.

2.4.2 System Operational Standards.

Table 6 identifies the values in this analysis which reflect current Army policy . . . .

TABLE 6. SYSTEM OPERATIONAL STANDARDS

Element	Value	Source	OPR	Ext
1. Utilization Rate	27 hr/mo	PM Projection	John Doe	73124
2. Acft per company	24 acft	PM Projection	John Doe	73124
3. Attrition Rate	2,6%/acft/yr 526 acft/15yrs	DAMA-XXX	Joe Doaks	77111
4. Pipeline Rate	8.4% ops acft	DAMA-XXX	Joe Doaks	77111
5. Modification Materiel	0.5% flyaway cost/acft/yr	DACA-XXX	Jack Smith	78192
6. Training Ammunition	$12,300/crew/yr	PM Projection	John Doe	73124

2.4.2.1 Utilization Rate.

The UAH-X will require about the same flying hours as the current helicopters to support the training . . . . The use of flight simulation will . . . .

2.4.2.2 Aircraft per Company.

The standard Division Air Support concept . . . .

2.4.2.3 Attrition Rate. . . . .

GUIDANCE: LIST THOSE FACTORS ESTABLISHED BY THE USING COMMAND WHICH IMPACT O&S COSTS IN A TABLE. A BRIEF EXPLANATION AND DERIVATION OF THE VALUE SHOWN FOLLOWS THE TABLE.

2.4.3 Standard Values and Rates.

Table 7 lists the standard values and rates used and the source . . . .

TABLE 7. STANDARD VALUES AND RATES

Element	Value	Source	OPR	Ext
1. POL Costs	$1.32/Gal	ASD(MRA&L)	Mary Doe	51234
2. Crew P&A	$20,914	AFPCH	-	-
3. Enlisted Standard Composite Rate	$11,291	AFPCH	-	-
4. Acft Service Life	20 years	ASD (COMP)	-	-
5. Escalation Factors	-	ASD (COMP)	-	-
6. Base Year Dollars	FY 80	CAIG	Tom Mix	75631

GUIDANCE: HIGHLIGHT THOSE STANDARD VALUES WHICH ARE ESTABLISHED AND GENERALLY ACCEPTED IN A TABLE. THESE VALUES ARE NOT SUBJECT TO INFLUENCE BY THE SYSTEM UNDER CONSIDERATION OR THE USING COMMAND.

3. METHODOLOGY

3.1 General.

For this analysis the Army O&S Cost estimating model was used. A summary of this model is provided in Appendix C . . . .

GUIDANCE: IF A GENERALLY APPLICABLE COMPUTERIZED COST ESTIMATING MODEL IS USED FOR THE ANALYSIS INSTEAD OF THE SERIES OF ALGORITHMS LISTED IN APPENDIX B OF THIS REPORT, INCLUDE SUMMARY OF THE MODEL USED, AS WELL AS APPROPRIATE COMPUTER PRODUCTS, IN APPENDIX C OF THE REPORT AND OMIT APPENDIX B.

3.2 Data Sources.

The sources used in defining the baseline costs and the method used in estimating the proposed system's cost are listed in Table 8 for each of the cost elements . . . .

GUIDANCE: INCLUDE A MATRIX OF SOURCES AND METHODS IN THE REPORT.

3.3 Derivation of Estimators.

In applying the baseline data to the UAH-X and projecting costs it was necessary to establish a proportional relationship between the two systems. These proportions are explained in the following paragraphs.

GUIDANCE: ESTABLISH SOME PROPORTIONAL RELATIONSHIP BETWEEN THE BASELINE SYSTEM AND THE ALTERNATIVES WHEN COST ANALYSIS DATA IS NOT DIRECTLY AVAILABLE FROM THE WEAPON SYSTEM UNDER CONSIDERATION. THIS RELATIONSHIP IS THEN USED TO SCALE THE BASELINE COSTS TO DETERMINE THE ESTIMATED COSTS OF THE ALTERNATIVE SYSTEMS.

GUIDANCE: DATA FOR THE BASELINE SYSTEM IS USUALLY AVAILABLE, HOWEVER, IT MAY NOT BE AVAILABLE ON THE PROPOSED SYSTEM, OR THE LEVEL OF DETAIL MAY NOT BE APPROPRIATE/SIGNIFICANT. THEREFORE, THE DATA OF THE BASELINE SYSTEM SHOULD BE CONSOLIDATED TO A SIGNIFICANT LEVEL OF DETAIL SO THAT IT MAY BE COMPARED TO THE PROPOSED SYSTEM.

TABLE 8 DATA SOURCES AND METHODOLOGY

COST ELEMENT	UH-1H & AH-1G BASELINE SOURCE	METHOD EXISTING DATA	UAH-X SYSTEM SOURCE	METHOD
MILITARY PERSONNEL				
Crew P&A	AFPCH, Oct. 1979	Normalized to a Cost/Co	Baseline	Built up by population
Maintenance P&A	AFPCH, Oct. 1979	Normalized to a Cost/Co	Baseline	Built up by population
Indirect P&A	AFPCH, Oct. 1979	Normalized to a Cost/Co	Baseline	Built up by population
PCS	AFPCH, Oct. 1979	Normalized to a Cost/Co	Baseline	Built up by population
CONSUMPTION				
Replenishment Spares	Selected Depot Reports	Normalized to a Cost/Co	Contractor Estimate	Normalized to a Cost/Co
POL	FM 101-20, Jan 79	Prorated based on mission	PM Estimate	Scaled by consumption
Ammo & Missiles	Training Directive	Built up by population	Baseline	Built up by population
DEPOT MAINTENANCE				
Airframe Repair	Selected Depot Reports	Normalized to a Cost/Co		Scaled by empty weight & flyaway costs
Engine Repair	Selected Depot Reports	Normalized to a Cost/Co		Scaled by Engine SHP & flyaway costs
Component Repair	Selected Depot Reports	Normalized to a Cost/Co	Contractor Estimate	Normalized to a Cost/Co
Transportation	No data base: CER used	Normalized to a Cost/Co	CER used	Scaled by empty weight
MODIFICATION MATERIEL	See Table 6	Normalized to a Cost/Co	See Table 6	Same as baseline
OTHER DIRECT SPT OPS	Not Available		Not Available	
INDIRECT SUPPORT OPS				
Pers Replacement	AFPCH, Oct. 79	Normalized to a Cost/Co	Baseline	Built up by population
Trans, Patients, Prisoners	AFPCH, Oct. 79	Normalized to a Cost/Co	Baseline	Built up by population
Quarters Maint & Utilities	AFPCH, Oct. 79	Normalized to a Cost/Co	Baseline	Built up by population
Medical Support	AFPCH, Oct. 79	Normalized to a Cost/Co	Baseline	Built up by population
Other Indirect	AFPCH, Oct. 79	Normalized to a Cost/Co	Baseline	Built up by population

3.3.1 Material Cost Scalar.

The material cost scalar of the UAH-X system is 2.4. Derivation follows:

a. Raw Materials Cost Factors

Type	Cost/Pound	Utilization Factor (Scrap Rate)	Cost/Pound of acft wt
Aluminum	$ 19.81	2.5	$ 49.54
Titanium	$100.57	3.1	$311.77
Steel	$ 12.47	3.9	$ 48.63
Composites	$139.00	1.3	$180.70
Other	$ 30.46	1.0	$ 30.46

b. Structural Weight Distribution

Type	UH-1H			UAH-X		
	% of total acft wt	Cost/Pound	Cost Factor	total % of acft wt	Cost/Pound	Cost Factor
Aluminum	66.4	$ 49.54	$32.89	21.2	$ 49.54	$10.50
Titanium	7.1	$311.77	$22.14	29.2	$311.77	$91.03
Steel	21.8	$ 48.63	$10.60	17.5	$ 48.63	$ 8.51
Composites	0	$180.70	0	27.4	$180.70	$49.51
Other	4.7	$ 30.46	$ 1.43	4.7	$ 30.46	$ 1.43
Total	100		$ 67.06	100		$160.98

c. UAH-X cost factor ÷ UH-1H cost factor = Material Scalar

$160.98 ÷ $67.06 - 2.4 material scalar

GUIDANCE: MANY OF THE ALTERNATIVE SYSTEM O&S COSTS WHICH CANNOT BE OBTAINED DIRECTLY MAY BE ESTIMATED BY DETERMINING THEIR RELATIONSHIP TO THE TOTAL COSTS OF THE BASELINE SYSTEM. REPLENISHMENT SPARES AND COMPONENT REPAIR ARE BUT TWO EXAMPLES OF SUCH COSTS. THEREFORE, IT IS OFTEN HELPFUL TO ESTABLISH A RELATIONSHIP BETWEEN THE BASELINE COSTS AND THE ESTIMATE OF THE ALTERNATIVE SYSTEM'S FACTORS COSTS.

3.4 Design/Environment Impact.

Based on a study of maintenance actions covering helicopter aircraft, subject: . . . dated . . . , it was found that 78% of the structural failures could have been avoided by redesign . . . as such, the assumption is made that . . . is the applicable factors . . . .

GUIDANCE: WHEN APPLYING ESTIMATING FACTORS TO A GIVEN COST, THAT COST CAN SOMETIMES BE SEPARATED INTO TWO PARTS: THOSE WHICH ARE RELATED TO THE DESIGN OF THE COMPONENT IN QUESTION AND THOSE WHICH ARE CONSTANT. INDUCED FAILURES, FALSE REMOVALS, STORAGE AND HANDLING LOSSES ARE EXAMPLES OF CONSTANT COSTS WHICH ARE NOT DIRECTLY DESIGN-RELATED AND SHOULD NOT BE FACTORED INTO THE COST ESTIMATE.

3.5 POL Consumption

POL consumption is dependent on the type mission being flown . . . . The mission mix for the UH-1H is 40% of the flying hours for troop delivery and 60% for cargo transport; for the AH-1G it is 67% for anti light armor and 33% for anti heavy armor . . . .

UH-1H POL Consumption

a. Fuel Capacity - 211 gal

b. Max Flying Time

1. Troop deployment: 2.46 hours max mission time + .33 hours reserve fuel = 2.79 hours
2. Cargo transport: 2.37 hours max mission time + .33 hours reserve fuel = 2.7 hours

c. Hourly consumption rate

1. Troop deployment - 211 gal ÷ 2.79 hours = 76 gal/hr
2. Cargo transport - 211 gal ÷ 2.7 hours = 78 gal/hr

d. Combined consumption rate

(76 gal/hr x 40%) + (78 gal/hr x 60%) = 77 gal/hr

AH-1G POL Consumption

a. Fuel Capacity

1. Anti light armor: 242 gal
2. Anti heavy armor: 196 gal

b. Max Flying Time

1. Anti light armor: 2.4 hours max mission time + .33 hours reserve fuel = 2.73 hours
2. Anti heavy armor: 1.8 hours max mission time + .33 hours reserve fuel = 2.13 hours

c. Hourly consumption rate

1. Anti light armor: 242 gal ÷ 2.73 hours = 89 gal/hr
2. Anti heavy armor: 196 gal ÷ 2.13 hours = 92 gal/hr

Combined Consumption rate

(89 gal/hr x 67%) + (92 gal/hr x 33%) = 90 gal/hr

Reference: FM 101-20, U.S. Army Aviation Planning Manual, January 1979

GUIDANCE: WHEN THE DERIVATION OF A VALUE USED IN THE COST ANALYSIS IS COMPLEX PROVIDE A DETAILED EXPLANATION.

4. SENSITIVITY/RISK ANALYSIS

Although the UAH-X system is still undergoing development, there is sufficient detail known to establish fairly accurate predictions. This coupled with a well-established and accurate data base provides a credible basis for the estimations . . . .

GUIDANCE: INCLUDE AN INDICATION OF THE CONFIDENCE IN THE FIGURES PRESENTED.

4.1 General.

Airframe Repair, Component Repair/Replacement and POL appear to present the greatest risk potential . . . .

GUIDANCE: DEVELOP A FURTHER, DETAILED ANALYSIS OF THE COST IMPACT OF EACH COST ELEMENT OFFERING A POTENTIAL FOR HIGH COSTS, ESPECIALLY THOSE OF WHICH THE VALUE ESTIMATED FOR THE O&S COST ANALYSIS COULD VARY WIDELY. IDENTIFY THE RANGE OF VALUES SELECTED FOR SENSITIVITY ANALYSIS AND THE RATIONALE FOR SELECTION. PRESENT THE RESULTS USING IDENTICAL GRAPHICAL VALUES WHENEVER POSSIBLE TO FACILITATE A COMPARISON.

4.2 Airframe Repair.

Scheduled Depot Level Maintenance costs were developed by the contractor using . . . .

. . . The estimates were then compared with current aircraft rework costs with the following results:

Acft	Costs Per Overhaul
AH-1G	$ 92.4 K
UH-1H	138.6 K
AH-1S	150.0 K
AA H	265.3 K
Black Hawk	280.2 K
UAH-X	331.6 K

Although there is little data on depot maintenance of aircraft with a high percentage of composite material, the estimate appears . . . .

The high value and low value were selected for their sensitivity analysis because . . . .

Airframe Repair Cost Range

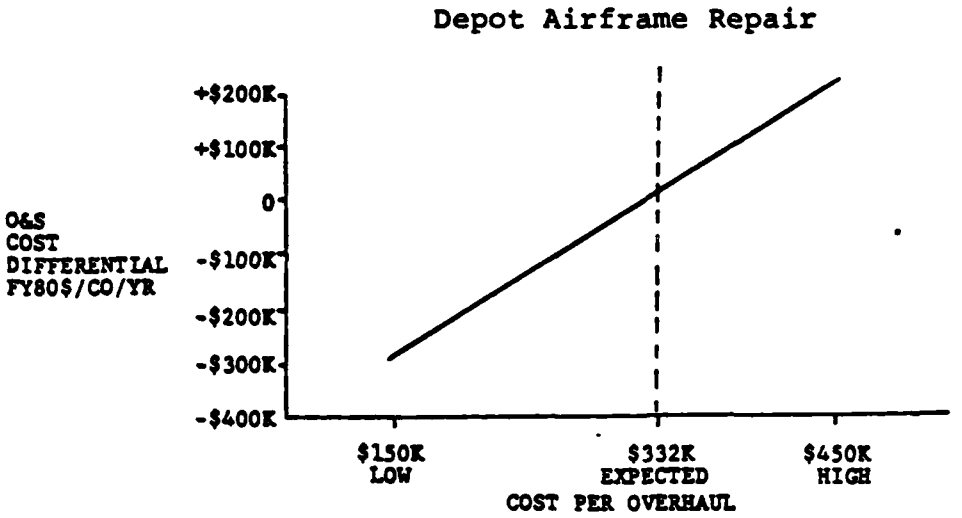
	Low	Expected	High
Cost/Airframe Overhaul	$150 K	$332 K	$450 K
Annual Cost/Co Difference	-$310.5 K	0	+$202.5 K

4.3 Component Repair/Replenishment Spares.

(See Table B-1)

The uncertainty associated with the weapon system components cost estimates are twofold: the uncertainty of the condemnation rates and the estimates of mean times between repair (MTBR) . . . .

	$/FH		
	Low	Expected	High
Replacement Costs	$ 95.00	$121.96	$140.00
Repair Costs	$135.00	$166.17	$250.00
Replenishment Spares	$ 738.7 K	$ 948.4 K	$1088.6 K
Component Repair	$1049.8 K	$1292.1 K	$1944.0 K
Annual Cost/Co Differences	-$ 452.0 K	0	+$ 792.1 K



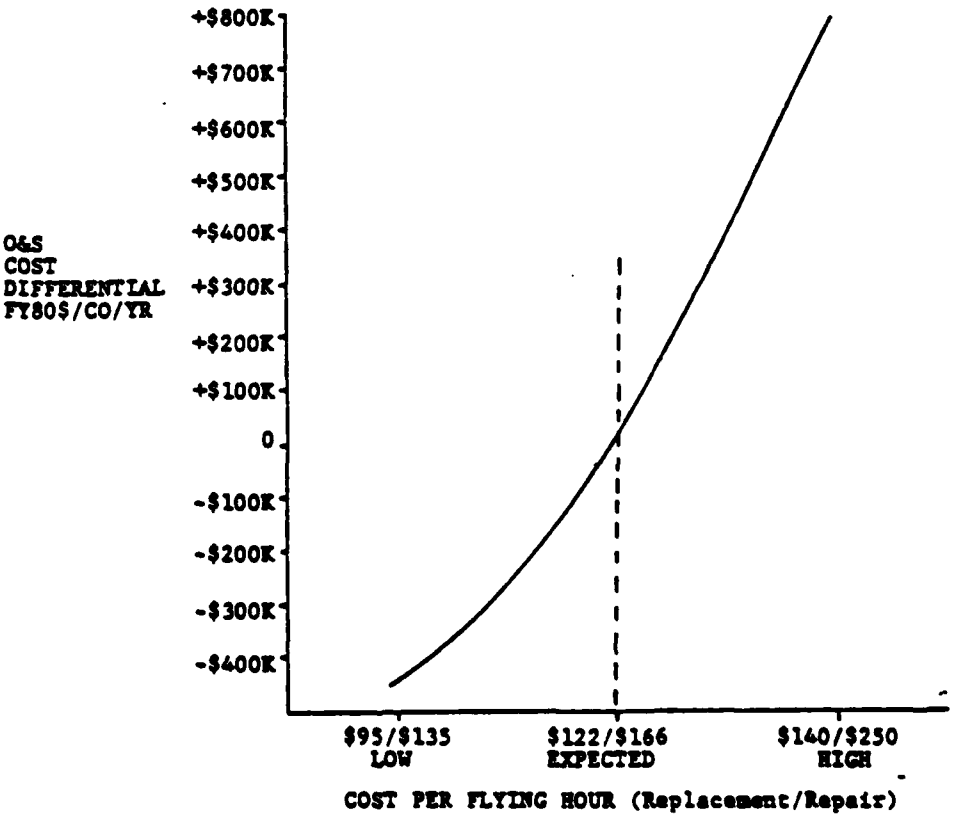


Figure 2. Sensitivity Graphs

4.4 POL Sensitivity.

There are two areas of risk associated with POL costs: the uncertainty of unit costs and the fuel consumption rate of a new weapon system . . . . To place the UAH-X system in the proper perspective, other comparable weapon systems are shown in Figure 3 . . . .

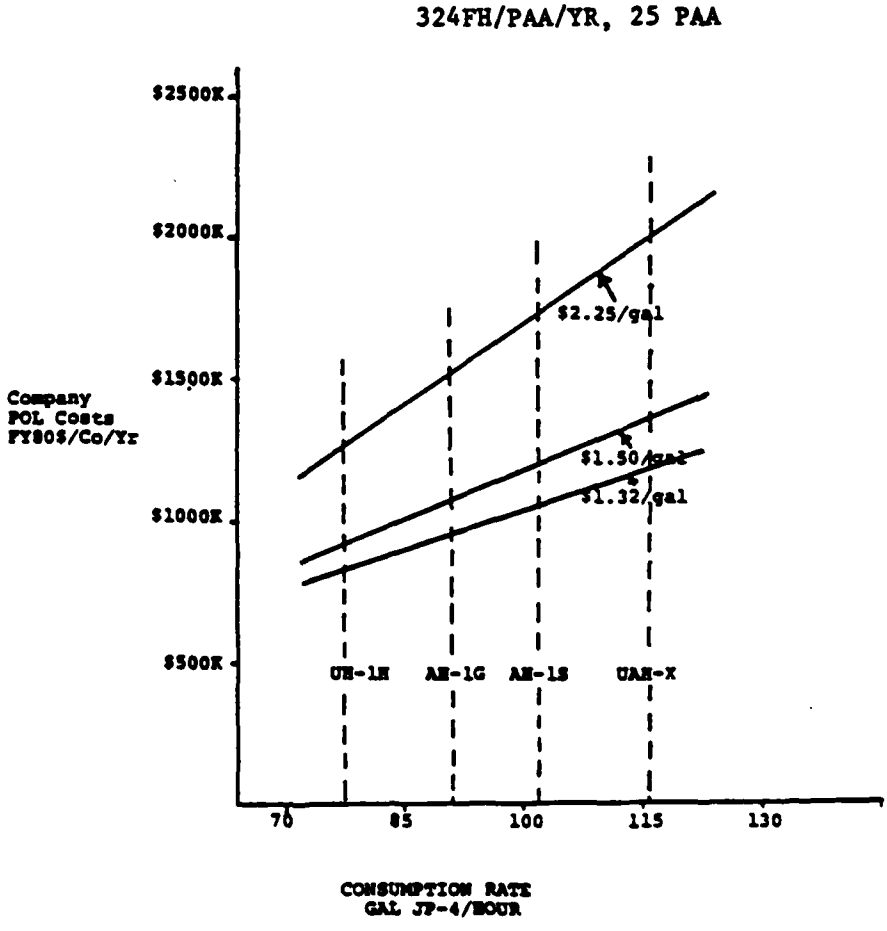


Figure 3. POL Sensitivity Graph

5. SUMMARY

Still to be resolved are the methods of determining and prorating other Direct Support Operations and Transporation . . . . It is anticipated that methods will be developed and values for these categories provided . . . .

GUIDANCE: NOTE ISSUES LEFT UNRESOLVED OR THOSE WHICH WILL RECEIVE CLOSE SCRUTINY IN THE FUTURE.

As the system is refined and more operational experience is obtained, test data will be used to predict mature system support costs. This will be especially evident in the Airframe and Component Repair cost estimations . . . .

GUIDANCE: IDENTIFY ANTICIPATED REFINEMENTS AND NEW APPROACHES TO THE COST ESTIMATING TECHNIQUES.

APPENDIX A. UNIT MISSION PERSONNEL

Table A.1 provides a summary of TOE personnel . . . .

A.1 General.

The UAH-X will be a high performance helicopter with the heavy lift capability necessary for the troop and supplies deployment missions . . . . Further, a design that focuses on greater flexibility and quicker turnaround time will allow for increased aircraft and crew utilization under combat conditions . . . . Although company manning reflects a slight increase over current manning levels it is expected that the greater flexibility and changed operational concepts will allow a decrease in the number of operational helicopter companies within the Army . . . . Detailed analysis of manpower requirements based on DMMH/FH and Army manning standards is available in DA - - . Copies may be obtained by contacting . . . .

GUIDANCE: EXPLAIN THE RATIONALE BEHIND MANNING CHANGES TO THE BASELINE SYSTEM. WHEN THE ALTERNATIVE SYSTEM INCORPORATES NEW CONCEPTS OR A RADICAL DEPARTURE FROM EXISTING SYSTEMS/METHODS, EXPLAIN IN DETAIL THE CHANGE AND ITS EXPECTED IMPACT ON MANNING.

A.2 Crew Members.

TOE manning provides for one crew member per seat . . . . The crew chief, listed under maintenance, will man the mini gun on assault missions and provide . . . .

A.3 Maintenance.

A.3.1 Overview.

Trends indicate that advanced system ILS planning will include . . . .

GUIDANCE: INCLUDE A DETAILED NARRATION OF FACTORS THAT IMPINGE ON MAINTENANCE MANNING AS A WHOLE, SUCH AS, THROWAWAY VS. REPAIR IMPACT, AND MAINTENANCE CONCEPT.

A.3.2 Organizational Maintenance. (AVUM)

Standard organizational maintenance concepts with one crew chief on flying pay for each helicopter is expected . . . . The use of composite materials and integrated electronics with alternate path circuitry will . . . . .

A.3.3 Intermediate Maintenance. (AVIM)

The use of intergrated electronics tends to increase repair times at the intermediate level, however, automatic test and calibrations support equipment will offset this . . . .

GUIDANCE: INCLUDE REASONS FOR EACH CHANGE IN MANNING TO THE LEVEL OF DETAIL KNOWN.

TABLE A.1. SUMMARY OF TOE MANNING

MOS	Assault PAA-29	Air Cavalry PAA-27	Air Ambulance PAA-25	Combined PAA-24 (UAH-X)
Crew	(42)	(44)	(50)	(48)
MOS 35	1	2	2	2
MOS 45	8	14	-	12
MOS 67 cr ch w/FP	15	18	25	24
MOS 67 cr ch wo/FP	6	9	-	-
MOS 67	22	20	12	18
MOS 68B	2	1	1	1
MOS 68D	1	1	1	1
MOS 68E	1	1	1	1
MOS 68F	1	1	1	1
MOS 68G	2	1	1	1
MOS 68H	1	1	1	1
Tech Inspection	5	5	4	5
Fuel Specialists	9	3	4	6
Ammo Spec	1	2	-	2
Mtil Supplyman	8	6	4	5
Maint Supv	8(1)	6(1)	8(1)	6(1)
Total Maintenance	92	92	66	87
Ind Operations	6(1)	3(1)	3(1)	4(1)
Ground Comm	7	4	15	7
Administration	1	4	3	3
Cooks	6	3	6	6
Unit Supplyman	3	1	6	4
Motor Pool Pers	11	40	9	20
Medics	-	-	24	24
Approach Control	-	-	5	3
Supervision	2(1)	4(1)	(1)	4(1)
Total Indirect	37	60	72	76
AVIM Additive	13	13	9	12
Total	184	209	197	223

( ) officers

APPENDIX B. MATHEMATICAL COMPUTATIONS

(All results in Thousands)

GUIDANCE: PROVIDE THE MATHEMATICAL COMPUTATIONS AND FORMULAS/ ALGORITHMS USED TO CALCULATE THE COST ELEMENTS. DO NOT DUPLICATE COMPUTATIONS PERFORMED IN MECHANIZED (COMPUTERIZED) MODELS DESCRIBED IN APPENDIX C.

MILITARY PERSONNEL

(Assumes 25% of force deployed to Europe)

Rank	Base Pay	Flight Pay	Total	Theater
O-1 to O-3	$19,239	$1,675	$20,914	$1562
WO	$19,863	$1,915	$21,775	$1562
E-1 to E-9	$10,345	$ 946	$11,291	$ 493

(Page II-3, AFPCH)

Crew Pay and allowances

Composite: officers 12 x $20,914	= $	250,968	
WO 36 x $21,775	= $	783,900	
Theater costs 48 x 25% x $1562	= $	18,744	
Total	=		$ 1,054K/Company (co)
Assault: officers 11 x $20,914	= $	230,054	
WO 31 x $21,775	= $	675,025	
Theater costs 42 x 25% x $1562	= $	16,401	
Total	=		$ 921K/co
Air Cavalry: officers 11 x $20,914	= $	230,054	
WO 33 x $21,775	= $	718,575	
Theater costs 44 x 25% x $1562	= $	17,187	
Total	=		$ 966K/co
Air Ambulance: officers 13 x $20,914	= $	271,882	
WO 37 x $21,775	= $	805,675	
Theater costs 50 x 25% x $1562	= $	19,525	
Total	=		$ 1,097K/co

Maintenance Pay & Allowances

Composite: WO 1 x $19,863	= $	19,863	
Crew Chief w/flt pay 24 x $11,291	= $	270,984	
Other Enlisted 62 x $10,345	= $	641,390	
Theater costs (1 x 25% x $1562) + (86 x 25% x $493)	= $	10,990	
Total	=		$ 943K/co
Assault: WO 1 x $19,863	= $	19,863	
Crew Chief w/flt pay 15 x $11,291	= $	169,365	
Other Enlisted 76 x $10,345	= $	786,220	

Maintenance Pay and Allowances cont.

Theater costs (1 x 25% x $1,562) + (91 x 25% x $493)	= $ 11,606	
Total	=	$ 987K/co
Air Cavalry: WO 1 x $19,863	= $ 19,863	
Crew Chief w/flt pay 18 x $11,291	= $203,238	
Other Enlisted 73 x $10,345	= $755,185	
Theater costs (1 x 25% x $1,562) + (91 x 25% x $493)	=	$ 990K/co
Air Ambulance: WO 1 x $19,863	= $ 19,863	
Crew Chief w/flt pay 25 x $11,291	= $282,275	
Other Enlisted 40 x $10,345	= $413,800	
Theater costs (1 x 25% x $1,562) + (62 x 25% x 493)	= $ 8,032	
Total	=	$ 742K/co

Indirect Pay and Allowances

Composite: Officers 2 x $19,239	= $ 38,478	
Enlisted 86 x $10,345	= $889,670	
Theater costs (2 x 25% x $1,562) + (86 x 25% x $493)	= $ 11,380	
Total	=	$ 940K/co
Assault: Officers 2 x $19,239	= $ 38,478	
Enlisted 48 x $10,345	= $496,560	
Theater costs (2 x 25% x $1,562) + (48 x 25% x $493)	= $ 7,478	
Total	=	$ 543K/co
Air Cavalry: Officers 2 x $19,239	= $ 38,478	
Enlisted 71 x $10,345	= $734,495	
Theater costs (2 x 25% x $1,562) + (71 x 25% x 493)	= $ 9,531	
Total	=	$ 783K/co
Air Ambulance: Officers 2 x $19,239	= $ 38,478	
Enlisted 79 x $10,345	= $817,255	
Theater costs (2 x 25% x $1,562) + (79 x 25% x $493)	= $ 10,518	
Total	=	$ 866K/co

PCS

Annual Rotation Rate

	CONUS	EUROPE
Officers	8%	34%
Enlisted	7%	46%

Rotation Costs

	CONUS TO CONUS	CONUS TO EUROPE & RETURN
Officers	$3,519	$12,509
Enlisted	$ 897	$ 4,137

(Page II-5 and II-6, AFPCH)

TABLE B.1. UAH-X COMPONENT DATA

(FY 80$)

MAJOR COMPONENTS	QTY PER A/C	CONDEMNATION RATE	REPLACEMENT COSTS	REPAIR COSTS	MTBR (FH)	REPLACEMENT COST PER F/H	COMPONENT REPAIR COST PER F/H
Main Rotor Blade	4	50%	16,726	10,820	1073	$31.18	$20.17
Main Rotor Hub	1	20%	59,509	18,195	1140	10.44	12.77
Swashplate	1	30%	12,749	3,916	1883	2.02	1.45
Main Transmission	1	10%	58,490	20,406	1400	4.18	13.12
Accessory Gearbox	2	30%	4,714	1,848	1700	1.66	1.52
Engine Gearbox	2	10%	7,950	3,321	1386	1.15	4.32
T/R Hanger Bearing	4	100%	328	--	1200	1.10	--
T/R Gearbox	1	10%	9,910	2,791	1224	.82	2.05
Auxiliary Power Unit	1	20%	25,128	6,641	1055	4.77	5.04
Intermediate Gearbox	1	10%	6,003	2,241	1271	.48	1.59
Main Rotor Actuator	3	10%	8,796	5,068	1578	1.67	8.66
Starter	2	10%	1,552	553	1854	.17	.53
Generator	2	20%	2,535	1,602	1950	.52	1.31
Tail Rotor Hub and Blade	2	50%	8,907	3,984	850	10.48	4.68
Engine Assembly	2	20%	149,704	34,431	8080	7.41	6.82
Hot Section	2	20%	27,263	6,271	2273	4.80	4.42
Accessory Gear Module	2	10%	24,907	5,729	3271	.76	3.33
Power Turbine Section	2	10%	27,390	6,300	2519	2.18	4.50
Cold Section	2	5%	74,766	17,196	1743	4.29	18.75
LRUS							
Inlet Particle Separator	2	30%	1,598	367	623	1.53	.83
HMU	2	5%	9,865	2,269	623	1.58	6.92
ECU	2	10%	9,322	2,144	623	3.00	6.19
SUBTOTAL						$94.66	$128.97
MINOR COMPONENTS						$27.30	$37.20
GRAND TOTAL						$121.96	$166.17

Source: Manufacturer's Estimate as approved by DA

CONUS
75% x No of officer/unit = CONUS officers
CONUS officers x Annual Rotation rate x Rotation Costs
75% x No of EM/unit = CONUS EM
CONUS EM x Annual Rotation rate x Rotation Costs

Europe
25% x No of officers/unit = Europe Officers
Europe officers x Annual Rotation rate x Rotation Costs
25% x No of EM/unit = Europe EM
Europe EM x Annual Rotation rate x Rotation Costs

Composite Company:

75% x 51 x 8% x $3,519	= $	10,768	CONUS OFF
75% x 172 x 7% x $897	= $	8,100	CONUS EM
25% x 51 x 34% x $12,509	= $	54,227	EUROPE OFF
25% x 172 x 46% x $4,137	= $	81,830	EUROPE EM
Total	= $	155K	PCS/Composite Co

Assault Company

75% x 45 x 8% x $3,519	= $	9,501	CONUS OFF
75% x 139 x 7% x $897	= $	6,546	CONUS EM
25% x 45 x 34% x $12,509	= $	47,847	EUROPE OFF
25% x 139 x 46% x $4,137	= $	66,130	EUROPE EM
Total	= $	130K	PCS/Assault Co

Air Cavalry Company

75% x 47 x 8% x $3,519	= $	9,924	CONUS OFF
75% x 162 x 7% x $897	= $	7,629	CONUS EM
25% x 47 x 34% x $12,509	= $	49,973	EUROPE OFF
25% x 162 x 46% x $4,137	= $	77,072	EUROPE EM
Total	= $	145K	PCS/Air Cavalry Co

Air Ambulance Company

75% x 53 x 8% x $3,519	= $	11,190	CONUS OFF
75% x 144 x 7% x $897	= $	6,781	CONUS EM
25% x 53 x 34% x $12,509	= $	56,353	EUROPE OFF
25% x 144 x 46% x $4,137	= $	68,509	EUROPE EM
Total	=	143K	PCS/Air Ambulance Co

CONSUMPTION

Replenishment Spares

UH-1H (TOTAL PROCUREMENT ÷ TOTAL FLYING HOUR PROGRAM)

1979 - $101,436K ÷ 1,153,440 Total FH	= $	87.94/FH
1980 - $102,253K ÷ 1,146,960 Total FH	= $	89.15/FH
Ave	= $	88.55/FH

AH-1G (TOTAL PROCUREMENT ÷ TOTAL FLYING HOUR PROGRAM

1979 - $15,017.6K ÷ 186,300 Total FH	= $	80.61/FH
1980 - $11,635.5K ÷ 162,325 Total FH	= $	71.68/FH
Ave	$	76.45/FH

Composite Company (See Table B-1)
UAH-X 24 PAA x 27FH x 12mo x $121.96/FH = $ 948.4K/co/yr

Assault Company
UH-1H 23PAA x 27FH x 12mo x $88.55/FH = $ 659.9K/co/yr
AH-1G 6PAA x 27FH x 12mo x $76.45/FH = $ 148.6K/co/yr
Total $659.9K + $148.6K = $ 808.5K/co/yr

Air Cavalry Company
UH-1H 18 PAA x 27FH x 12mo x $88.55/FH = $ 516.K/co/yr
AH-1G 9 PAA x 27FH x 12mo x $76.45/FH = $ 222.9K/co/yr
Total $516.5K + $222.9K = $ 739.4K/co/yr

Air Ambulance Company
UH-1 25 PAA x 27FH x 12mo x $88.55FH = $ 717.3K/co/yr

POL (See Paragraph 3.6)

Composite Co (PAA: 24 UAH-X)
324FH x 115 gal/hr x $1.32/gal = $ 49.2K/acft
$49.2K x 24 acft = $ 1,180K/co

Assault Co (PAA: 23 UH-1H, 6 AH-1G)
324FH x 77 gal/hr x $1.32/gal = $ 32.9K/acft
$32.9K x 23 acft = 757K/co
324FH x 90 gal/hr x $1.32/gal = $ 38.5K/acft
$38.5K x 6 aft = $ 231K/co
$757K + $231K = $ 988K /co

Air Cavalry (PAA: 18 UH-1H, 9 AH-1G)
324FH x 77 gal/FH x $1.32 = $ 32.9K/acft
$32.9K x 18 acft = $ 592K/co
324FH x 90 gal/FH x $1.32 = $ 38.5K/acft
$38.5K x 9 acft = $ 347K/co
$592K + $347K = $ 939K /co

Air Ambulance Co (PAA: 25 UH-1H)
324FH x 76 gal/FH x $1.32 = $ 32.5K/acft
$32.5K x 25 acft = $ 813K /co

Ammunitions and Missiles

Crew training costs (Attack only) $12,300/man/yr
Small arm's qualifications - 366 rounds
crew - 38 cal: $0.06 per round
other - 5.56 (M-16): $0.15 per round
Crew costs x No of crew = $cost/co/yr
Cost of .38 x 366 rounds x No of crew - cost /co/yr
Cost of 5.56 x 366 rounds x No of other personnel = cost/co/yr

TABLE B.2. AIR FRAME REPAIR

(ALL FIGURES IN THOUSANDS FY80$)

	Direct Labor	Indirect Labor	Overhead	Material	Misc.	Total	Qty	Ave Per Unit
AH-1G								
Overhaul								
1979 ORG	342.5	419.4	77.2	151.7		990.8	11	90.1
1980 ORG	67.3	84.5	8.7	50.2		210.7	2	105.4
Total	409.8	503.9	85.9	201.9		1201.5	13	92.4
Repair								
1979 ORG	19.4	22.8	4.4	24.1	7.8	78.5	18	4.4
1979 CTR						163.9	30	5.5
1980 ORG	4.0	4.9	.5	8.7		18.1	5	3.6
Total	23.4	27.7	4.9	32.8	7.8	260.5	53	4.9
UH-1H								
Overhaul								
1979 ORG	9126.6	11932.2	1780.8	11771.2		34610.8	239	144.8
1980 ORG	7802.4	9636.0	1011.1	9033.5	1.5	27484.5	209	131.5
Total	16929.0	21568.2	2791.9	20804.7	1.5	62095.3	448	
Ave cost/unit	37.8	48.1	6.2	46.4	0	138.6		
Repair								
1979 ORG	165.8	221.0	34.3	41.8	.1	463.0	234	20
1980 ORG	63.4	77.3	10.0	26.8	1.2	178.7	129	1.4
Total	229.2	298.3	44.3	68.6	1.3	641.7	363	1.8
Ave cost/unit	.6	.8	.1	.2	0	1.8		

Composite Company:

$12,300 x 48	= $	590.4K/co/yr
$.06 x 366 x 48	= $	1.0K/co/yr
$.15 x 366 x 175	= $	9.6K/co/yr
Total	= $	601.0K/co/yr

Assault Company:

$12,300 x 12	= $	147.6K/co/yr
$.06 x 366 x 43	= $	.9K/co/yr
$.15 x 366 x 142	= $	7.8K/co/yr
Total	= $	156.3K/co/yr

Air Cavalry Company:

$12,300 x 18	= $	221.4K/co/yr
$.06 x 366 x 44	= $	1.0K/co/yr
$.15 x 366 x 165	= $	9.0K/co/yr
Total	= $	231.4K/co/yr

Air Ambulance Company:

$12,300 x 0	= $	0
$.06 x 366 x 48	= $	1.0K/co/yr
$.15 x 366 x 149	= $	8.2K/co/yr
Total	= $	9.2K/co/yr

DEPOT MAINTENANCE

Airframe Overhaul

UH-1H

Time between scheduled overhaul - 10.3 years (124mo)

Meantime between unscheduled repair - 4850FH

COST PER OVERHAUL - $138.6K: PER REPAIR - $1.8K

AH-1G

Time between scheduled overhaul - 10 years (120mo)

Meantime between unscheduled repair - 3265FH

COST PER OVERHAUL- $92.4K: PER REPAIR- $4.9K

Assault Company

UH-1H

23 PAA x 12mo	= 276mo/yr
276mo ÷ 124mo	= 2.23 scheduled overhauls/yr
2.23 x $138.6K per overhaul	= $309.1K overhaul costs/yr
23 PAA x 27FH/mo x 12mo	= 7452FH/co/yr
7452FH ÷ 4850FH/repair	= 1.54 repairs/co/yr
1.54 x $1.8K/repair	= $2.8K repair costs/yr
$309.1K + $2.8K	= $311.9K depot airframe costs

AH-1G

6 PAA x 12 mo	= 72 mo/yr
72 mo ÷ 120 mo	= .6 scheduled overhauls/yr
.6 x $92.4K per overhaul	= $55.6K overhaul costs/yr
6 PAA X 27FH/mo x 12 mo	= 1944FH/co/yr
1944FH ÷ 3265FH	= .6 repairs/co/yr
.6 x $4.9K/repair	= $2.9K repair costs/yr
$55.6K + $2.9K	= $58.5K depot airframe cost

Total Costs = $311.9K + $58.5K = $370.4K/co/yr

Air Cavalry Company

UH-1H

18 PAA x 12 mo	= 216 mo/yr
216 mo ÷ 124 mo	= 1.74 scheduled overhauls/yr
1.74 x $138.6K per overhaul	= $241.2K overhaul costs /yr
18 PAA x 27FH/mo x 12 mo	= 5832FH/co/yr
5832FH ÷ 4850FH/repair	= 1.20 repairs/co/yr
1.20 x $1.8K/repair	= $2.2K repair costs
$241.2K + $2.2K	= $243.4K depot airframe costs /yr

AH-1G

9 PAA x 12 mo	= 108 mo/yr
108 mo ÷ 124 mo	= .87 scheduled overhauls/yr
.87 x $92.4K per overhaul	= $80.4K overhaul costs /yr
9 PAA x 27FH/mo x 12 mo	= 2916FH/co/yr
2916FH ÷ 3265FH	= .89 repairs/co/yr
.89 x $4.9K/repair	= $4.4K repair costs /yr
$80.4K + $4.4K	= $84.8K depot airframe costs
Total Costs	= $243.4K + $84.8K = $328.2K/co/yr

Air Ambulance

UH-1H

25 PAA x 12 mo	= 300 mo/yr
300 mo ÷ 124 mo	= 2.42 scheduled overhauls/yr
2.42 x $138.6K per overhaul	= $335.3K overhaul costs /yr
25 PAA x 27FH x 12 mo	= 8100FH/co/yr
8100FH ÷ 4850FH/repair	= 1.67 repairs/co/yr
1.67 x $1.8K/repair	= $3.0K repair costs /yr
Total Costs	= $335.3K + $3.0K = $338.3K/co/yr

Composite Company

UAH-X

UH-1H data used as baseline (See Table B.2)

Labor costs scaled by empty weight

8500 lbs ÷ 5210 lbs = 1.63

Material costs scaled by empty weight and material costs (1.63, 2.4)

Overhaul per unit

Labor

UH-1H : $37.8K + $48.1K + $6.2K = $92.1K labor

$92.1K x 1.63 = $150.1K labor cost of overhaul

Material

UH-1H - $46.4K Material

$46.4K x 1.63 x 2.4 = $181.5K Material cost of overhaul

$150.1K + $181.5K = $331.6K cost of UAH-X overhaul /unit

Repair per unit

Labor

UH-1H - $.6K + $.8K + $.1K = $1.5K Labor

$1.5K x 1.63 = $2.4K labor cost of repair

Material

UH-1H - $.2K Material

$.2K x 1.63 x 2.4 = $.8K material cost of repair

$2.4K + $.8K = $3.2K cost of UAH-X repair/unit

TABLE B.3. ENGINE REPAIR

(ALL FIGURES IN THOUSANDS FY80$)

	Direct Labor	Indirect Labor	Overhead	Material	Total	Qty	Ave Per Unit
AH-1G							
Overhaul							
1979	298.9	432.6	58.9	1028.7	1819.1	50	36.4
1980	141.3	179.5	23.4	582.7	926.9	36	25.8
Total	440.2	612.1	82.3	1611.4	2746.0	86	31.9
Repair							
1979	90.7	128.0	17.7	197.3	433.7	36	12.1
1980	275.1	354.9	30.4	1000.4	1660.8	60	27.7
Total	365.8	482.9	48.1	1197.7	2094.5	96	21.8
UH-1H							
Overhaul							
1979	2436.1	3344.5	484.3	8367.0	14631.9	486	30.1
1980	772.4	978.5	122.3	3976.6	5849.7	179	32.7
Total	3208.5	4323.0	606.6	12343.5	20481.6	665	30.8
Ave costs/unit	4.8	6.5	.9	18.6	30.8		
Repair							
1979	260.1	373.3	49.7	977.0	1660.1	90	18.4
1980	1457.6	1857.6	170.1	6044.5	9529.8	346	27.5
Total	1717.7	2230.9	219.8	7021.5	11189.9	436	25.7
Ave costs/unit	3.9	5.1	.5	16.1	25.7		

Overhaul Costs

Time between scheduled overhaul - Estimated 14 yrs (168 mo)
24 PAA x 12 mo = 288 mo/co/yr
288/mo ÷ 168 mo = 1.71 overhaul per year
1.71 x $331.6K/overhaul = $567.0K overhaul costs/yr

Repair Costs

Estimated mean time between unscheduled repair - 6000FH
24 PAA x 27FH x 12 mo = 7776FH/co/yr
7776FH ÷ 6000FH = 1.3 repairs/co/yr
1.3 x $3.2K/repair = $4.2K repair costs /yr

Total - $567.0K + $4.2K = $571.2K/co/yr

Engine Repair

UH-1H

Time between scheduled overhaul - 2000FH
Mean FH between unscheduled repair- 2042FH
COST PER ENGINE OVERHAUL- $30.8K : PER REPAIR- $25.7K

AH-1G

Time between scheduled overhaul - 1500FH
Mean FH between unscheduled repair - 1344FH
COST PER ENGINE OVERHAUL- $31.9K : PER REPAIR $21.8K

Assault Company

UH-1H

23 PAA x 27FH/mo x 12 mo	= 7452FH/yr
7452FH ÷ 2000FH overhaul interval	= 3.73 overhauls/yr
3.73 x $30.8K/overhaul	= $114.8K overhaul costs/yr
7452FH ÷ 2042FH repair interval	= 3.65 repairs/yr
3.65 x $25.7K/repair	= $93.8K repair costs /yr
$114.8K + $93.8K	= $208.6K depot repair costs

AH-1G

6 PAA x 27FH/mo x 12 mo	= 1944 FH/yr
1944FH ÷ 1500 overhaul interval	= 1.30 overhauls/yr
1.30 x $31.9K/overhaul	= $41.3K overhaul costs /yr
1944FH ÷ 1344FH repair interval	= 1.45 repairs/yr
1.45 x $21.8K/repair	= $31.5K repair costs /yr
$41.3K + $31.5K	= $72.8K depot repair costs
Total	= $208.6K + 72.8K = $281.4K /co/yr

Air Cavalry Company

UH-1H

18 PAA x 27FH/mo x 12 mo	= 5832FH/yr
5832FH ÷ 2000FH overhaul interval	= 2.92 overhauls/yr
2.92 x $30.8K overhaul	= $89.8K overhaul costs /yr
5832FH ÷ 2042 FH repair interval	= 2.86 repairs/yr
2.86 x $25.7K/repair	= $73.4K repair costs /yr
$89.8K + $73.4K	= 163.2K depot repair costs

AH-1G

9 PAA x 27FH/mo x 12 mo	= 2916FH/yr
2916FH ÷ 1500FH overhaul interval	= 1.94 overhauls/yr
1.94 x $31.9K/overhaul	= $62.0K overhaul costs/yr
2916FH ÷ 1344 repair interval	= 2.17 repairs/yr
2.17 x $21.8K/repair	= $47.3K repair costs/yr
$62.0K + 47.3K	= $109.3K depot repair costs
Total	= $163.2K + $109.3K = $272.5K/co/yr

Air Ambulance Company

UH-1H

25 PAA x 27FH/mo x 12 mo	= 8100FH/yr
8100FH ÷ 2000FH overhaul interval	= 4.05 overhauls/yr
4.05 x $30.8K/voerhaul	= $124.7K overhaul costs/yr
8100FH ÷ 2042 repair interval	= 3.97 repairs/yr
3.97 x $25.7K	= $102.0K repair costs/yr
$124.7K + $102.0K	= $226.7K/co/yr

Composite Company

UAH-X

UH-1H data used as baseline (See Table B.3)

Labor costs scaled by engine SHP

T53-L-15A SHP ÷ T53-L-13B SHP = 2950 ÷ 1400 = 2.11

Material costs scaled by engine SHP and material costs (2.11, 2.4)

Overhaul per engine

Labor

UH-1H - $4.8K + $6.5K + $.9K = $12.2K Labor

$12.2K x 2.11 = $25.7K labor cost of overhaul/engine

Material

UH-1H = $18.6K

$18.6K x 2.11 x 2.4 = $94.2K Material cost of overhaul/engine

$25.7K + $94.2K = $119.9K cost of UAH-X overhaul/engine

Repair per engine

Labor

UH-1H - $3.9K + $5.1K + $.5K = $9.5K Labor

$9.5K x 2.11 = $20.0K labor cost of repair/engine

Material

UH-1H Material costs - $16.1K

$16.1K x 2.11 x 2.4 = $97.6K Material cost of repair/engine

$20.0K + $97.6K = $117.6K cost of repair/engine

Overhaul Costs

Time between schedlued overhauls - Estimated 3500FH

24 PAA x 27FH x 12 = 7776FH/co/yr

7776FH ÷ 3500FH = 2.22 engine overhauls/co/yr

2.22 x $119.9K/overhaul = $266.2K/co/yr

Repair Costs

Estimated mean FH between repairs-4500FH

7776FH ÷ 4500FH = 1.7 repairs/co/yr

1.7 x $117.6K/engine repair = $199.9K/co/yr

Total $266.2K + $199.9K = $466.1K/co/yr

Component Repair

UH-1H (Total Repair Costs ÷ Total Flying Hour Program)

1979 - $167,440.0K ÷ 1,153,440 Total FH	= $145.17/FH
1980 - $141,510.0K ÷ 1,146,960 Total FH	= $123.38/FH
Ave	= $134.30/FH

AH-1G (Total Repair Costs ÷ Total Flying Hours Program)

1979 - $22,747.2K ÷ 186,300 Total FH	= $122.10/FH
1980 - $18,790.7K ÷ 162,325 Total FH	= $115.76/FH
Ave	= $119.15/FH

Assault Company

UH-1H - 23 PAA x 27FH x 12 mo x $134.30/FH	= $1000.8K/co/yr
AH-1G - 6 PAA x 27FH x 12 mo x $119.15/FH	= $ 231.6K/co/yr
Total - $1000.8K + $231.6K	= $1232.4K/co/yr

Air Cavalry Company

UH-1H - 18 PAA x 27FH x 12 mo x $134.30/FH	= $ 783.2K/co/yr
AH-1G - 9 PAA x 27FH x 12 mo x $119.15/FH	= $ 347.4K/co/yr
Total - $783.2K + $347.4K	= $1130.6K/co/yr

Air Ambulance Company

UH-1H - 25 PAA x 27FH x 12 mo x $134.30/FH	= $1087.8K/co/yr

Composite Company (See Table B-I)

UAH-X - 24 PAA x 27FH x 12 mo x $166.17/FH	= $1292.1K/co/yr

Transportation:

A. CER used is contained in USAAVSCOM Technical Report 75-54. Copy available upon request from _____ ext _____.

Short ton (ST)/FH	=	.000785 + .000000854 Empty weight
UH-1H ST/FH	=	.000785 + .000000854 x 5210
ST/FH	=	.005234
AH-1G ST/FH	=	.000785 + .000000854 x 5816
ST/FH	=	.005752
UAH-X ST/FH	=	.000785 + .000000854 x 8500
ST/FH	=	.008044

B. $96 - CONUS cost per S Ton
$430 - Europe cost per S Ton
(page II-8, AFPCH)
$96 x 75% + $430 x 25% = $180 per S Ton composite rate

C. Composite Company
.008044 x 324FH/acft x 24 acft x $180 = $ 11.3K/co/yr

Assault Company

.005234 x 324FH/acft x 23 UH-1H x $180	= $ 7.0K
.005752 x 324FH/acft x 6 AH-1G x $180	= $ 2.0K
Total	= $ 9.0K/co/yr

Air Cavalry Company
.005234 x 324FH/acft x 18 UH-1H x $180 = $5.5K
.005752 x 324FH/acft x 9 AH-1G x $180 = $3.0K
Total = $8.5K/co/yr

Air Ambulance Company
.005234 x 324FH/acft x 25 UH-1H x $180 = $7.6K/co/yr

MODIFICATION MATERIAL

Modification Material
Modification factor - 0.5% flyaway cost/acft/yr
(See Table 6)

Composite Company
0.5% x $2,300K x 24 acft = $276K/co/yr

Assault Company
UH-1H 0.5% x $1,280K x 23 acft = $147.2K
AH-1G 0.5% x $1,600K x 6 acft = $ 48.0K
Total = $195.2K/co/yr

Air Cavalry Company
UH-1H 0.5% x $1,280K x 18 acft = $115.2K
AH-1G 0.5% X $1,600K x 9 acft = $ 72.0K
Total = $187.2K/co/yr

Air Ambulance Company
UH-1H 0.5% x $1,280K x 25 acft = $160K/co/yr

INDIRECT SUPPORT OPERATIONS

Personnel Replacement

	Officers	EM
Annual Attrition Rate	10%	26.1%
Average Replacement Costs	$5,906	$1,797

(page VI-1 and VI-2, AFPCH)

No of officers/Co x Annual Attrition Rate x Average Replacement Cost
No of EM/Co x Annual Attrition Rate x Average Replacement Cost

Composite Company
51 x 10% x $5,906 = $30,121
172 x 26.1% x $1,797 = $80,671
Total = $111K/co/yr

Assault Company
45 x 10% x $5,906 = $26,577
139 x 26.1% x $1,797 = $65,193
Total = $92K/co/yr

Air Cavalry
47 x 10% x $5,906 = $27,758
162 x 26.1% x $1,797 = $75,981
Total = $104K/co /yr

Air Ambulance
53 x 10% x $5,906 = $31,302
144 x 26.1% x $1,797 = $67,538
Total = $99K/co/yr

Transients, Patients, Prisoners
TPP factor - 3.6% (page VI-2, AFPCH)

Personnel Pay & Allowances x TPP factor

Composite Co
($1,054K + $943K + $940K) x 3.6% = $106K/co/yr

Assault Co
($921K + $987K + $543K) x 3.6% = $ 88K/co/yr

Air Cavalry Co
($966K + $990K + $783K) x 3.6% = $ 99K/co/yr

Air Ambulance Co
($1,097K + $724K + $866K) x 3.6% = $ 97K/co/yr

Quarters Maintenance and Utilities (page VI-3, AFPCH)
CONUS: 75% x No of personnel x $581
Europe: 25% x No of personnel x $768

Composite Co
75% x 223 x $581 = $97,172
25% x 223 x $768 = $42,816
Total = $140K/co/yr

Assault Co
75% x 184 x $581 = $80,178
25% x 184 x $768 = $35,328
Total = $116K/co/yr

Air Cavalry Co
75% x 209 x $581 = $91,072
25% x 209 x $768 = $40,128
Total = $131K/co/yr

Air Ambulance Co
75% x 197 x $581 = $85,843
25% x 197 x $768 = $37,824
Total = $124K/co/yr

Medical Support (page VI-3, AFPCH)
CONUS: 75% x No of personnel x $317
Europe: 25% x No of personnel x $356

Composite Co	
75% x 223 x $317	= $53,018
25% x 223 x $356	= $19,847
Total	= $73K/co/yr
Assault Co	
75% x 184 x $317	= $43,746
25% x 184 x $356	= $16,376
Total	= $60K/co/yr
Air Cavalry Co	
75% x 209 x $317	= $49,690
25% x 209 x $356	= $18,601
Total	= $68K/co/yr
Air Ambulance	
75% x 197 x $317	= $46,837
25% x 197 x $356	= $17,533
Total	= $64K/co/yr

Other Indirect

A. Personnel Support

$3841 x manpower	= CONUS costs
($3841 + $2882) x manpower	= Europe costs
(page II-9, AFPCH)	
Composite Company	
$3841 x 75% x 223	= $ 642.4K
($3841 + $2882) x 25% x 223	= $ 374.8K
Total	= $1,017.2K/co/yr
Assault Company	
$3841 x 75% x 184	= $ 530.1K
($3841 + $2882) x 25% x 184	= $ 309.3K
Total	= $ 839.4K/co/yr
Air Cavalry Company	
$3841 x 75% x 209	= $ 602.1K
($3841 + $2882) x 25% x 209	= $ 351.3K
Total	= $ 953.4K/co/yr
Air Ambulance Company	
$3841 x 75% x 197	= $ 567.5K
($3841 + $2882) x 25% x 197	= $ 331.1K
Total	= $ 898.6K/co/yr

B. Non Personnel Support (Note: Support to non primary weapon system equipment, such as, jeeps, trucks, etc.)

Attack Helicopter - $10K/acft/yr
Utility Helicopter - $12K/acft/yr
UAH-X Helicopter - $15K/acft/yr

Composite Company	
24 acft x $15K	= $360K/co/yr
Assault Company.	
23 UH-1H x $10K	= $230K
6 AH-1G x $12K	= $ 72K
Total	= $302K/co/yr
Air Cavalry Company	
18 UH-1H x $10K	= $180K
9 AH-1G x $12K	= $108K
Total	= $288K/co/yr
Air Ambulance Company	
25 UH-1H x $10K	= $250K/co/yr

Total Other Indirect

Composite Company $1,017.2K + $360K	= $1377.2K/co/yr
Assault Company $839.4K + $302K	= $1141.4K/co/yr
Air Cavalry Company $953.4K + $288K	= $1241.2K/co/yr
Air Ambulance Company $898.6 + $250K	= $1148.6K/co/yr

APPENDIX C. O&S COST ESTIMATING MODEL

C.1 General.

For this analysis the Army . . . . model was used . . . . This model is a deterministic mathematical model which is preprogrammed and completely structured . . . .

C.2 Use & Application.

This model has been in use since . . . calculates annual company operating costs . . . .

C.3 Model Logic.

Table C-1 lists the algorithms used in the model logic . . . .

C.4 Results.

Tables C.2.A through C.2.( ) are the computer products identifying both input values and results for each alternative . . . .

GUIDANCE: THE FORMAT USED AND THE INFORMATION PROVIDED IN APPENDIX C DEPEND ON THE COMPUTER MODEL USED. IF APPENDIX C IS USED APPENDIX B WILL BE OMITTED.

TABLE C.1. O&S COST ESTIMATING MODEL ALGORITHMS

UNIT MISSION PERSONNEL

Aircrew
A = Aircrew (Officer) x Officer P&A
B = Aircrew (Enlisted) x Enlisted P&A

Maintenance
C = Maint (Officers) (less air crew) x Officer P&A
D = Maint (Enlisted) x Enlisted P&A

Indirect Personnel
E = Other Officers x Officer P&A
F = Enlisted x Enlisted P&A

CONSUMPTION

POL
G = Consumption Rate x POL unit costs x flying
Hours per air craft x PAA acft/company x K factor

Ammunition & Missiles
H =

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INDIRECT SUPPORT OPERATIONS

Personnel Replacement
FF = Recruiting Cost factor x Company Personnel x
Turnover Rate x K factor

GUIDANCE: WHEN FACTORS ARE USED, INSURE THAT THE EQUATION FROM WHICH THE FACTOR IS DERIVED IS INCLUDED.

TABLE C.2.A. ANNUAL COMPANY OPERATION AND SUPPORT COST ANALYSIS

MODEL:
TIME: 1719.0 Fri 02/08/80

COMPUTER PROGRAM:
DATA FILE:

GENERAL

PAA/CO 24
CREWS/PAA..........2.0

FH/PAA/YR - PEACE 27
WAR ....N/A

INPUT VALUES	OFFICER	ENLISTED	CIVILIAN	TOTAL
No of Aircrew	48	0	0	48
No of Maintenance Pers	1	86	0	87
Other Pers	2	86	0	88

POL costs - $1.32/gal

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Acquisition K factor - ...
Individual Training K factor - ...

TABLE C.2.A. (CONTINUED) ANNUAL SQUADRON OPERATION AND SUPPORT ANALYSIS
TIME: 1919.0 Fri 02/08/80 DATA FILE:

RUN RESULTS:

Military Personnel		3092
Crew P&A	1054	
Maintenance P&A	943	
Indirect P&A	940	
PCS	155	
Consumption		2718
Replenishment Spares	948	
POL	1180	
Ammunition & Missiles	590	
Depot Maintenance		2340
Airframe Repair	571	
Engine Repair	466	
Component Repair	1292	
Transportation	11	
Modification Material		276
Other Direct Support Ops		-
Maintenance Civilian Labor	-	
Other Direct	-	
Indirect Support Ops		1807
Personnel Replacement	111	
Transients, Patients, & Prisoners	106	
Quarters Maintenance & Utilities	140	
Medical Support	73	
Other Indirect	1377	
Total Cost Per Company		10,233

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